

# Department of Energy Road Show

Cummins Power Generation

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Energy Solutions Business

Western Regional Manager

1250 kW<sub>e</sub> Continuous Rated  
38.6 electrical efficiency



# Cummins Inc.

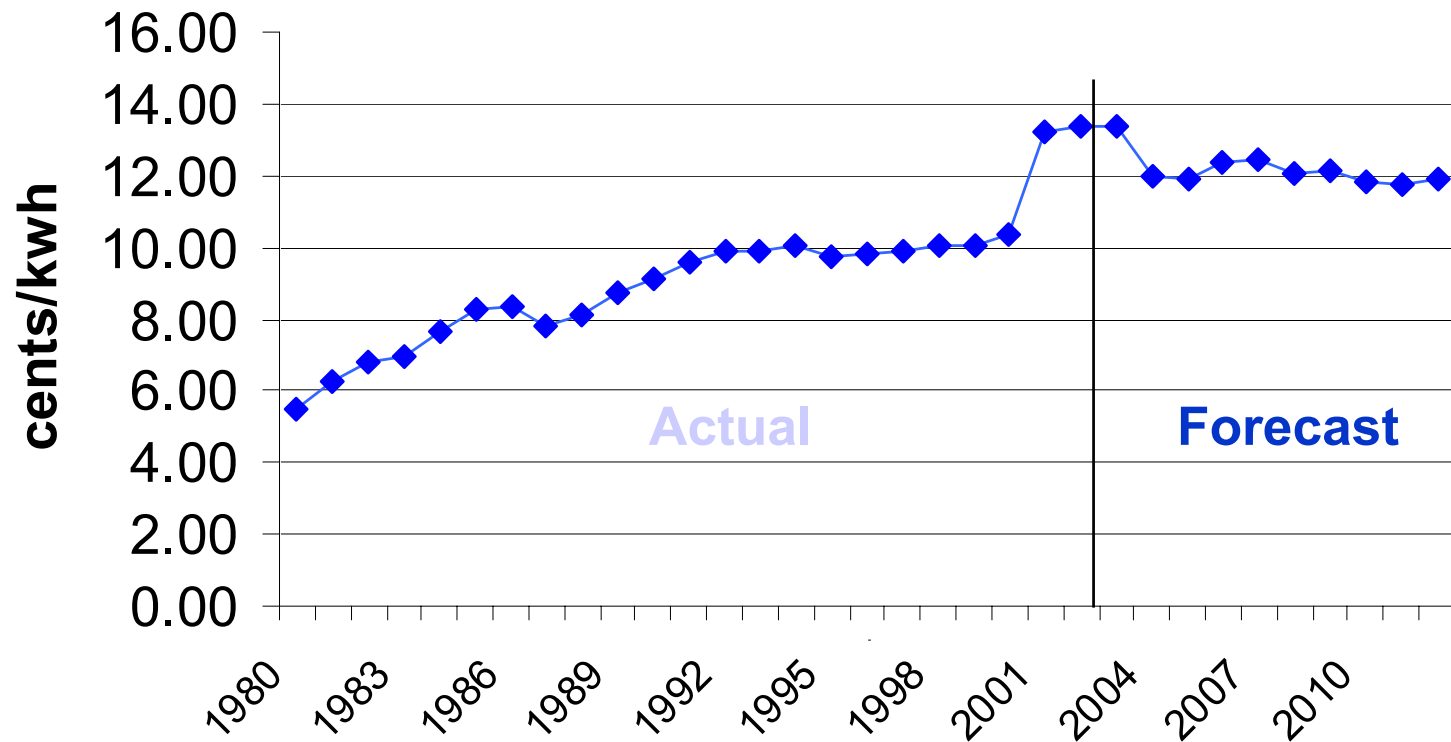
- \$6.6 B Sales
- \$ 1.4 B Sales in Power Generation
- World Wide Facilities
  - Over 50 Manufacturing Plants
  - 7 Technical Centers
  - 8 Parts and Distribution Centers
- Sales and Service World Wide
  - Over 500 Distributor Facilities

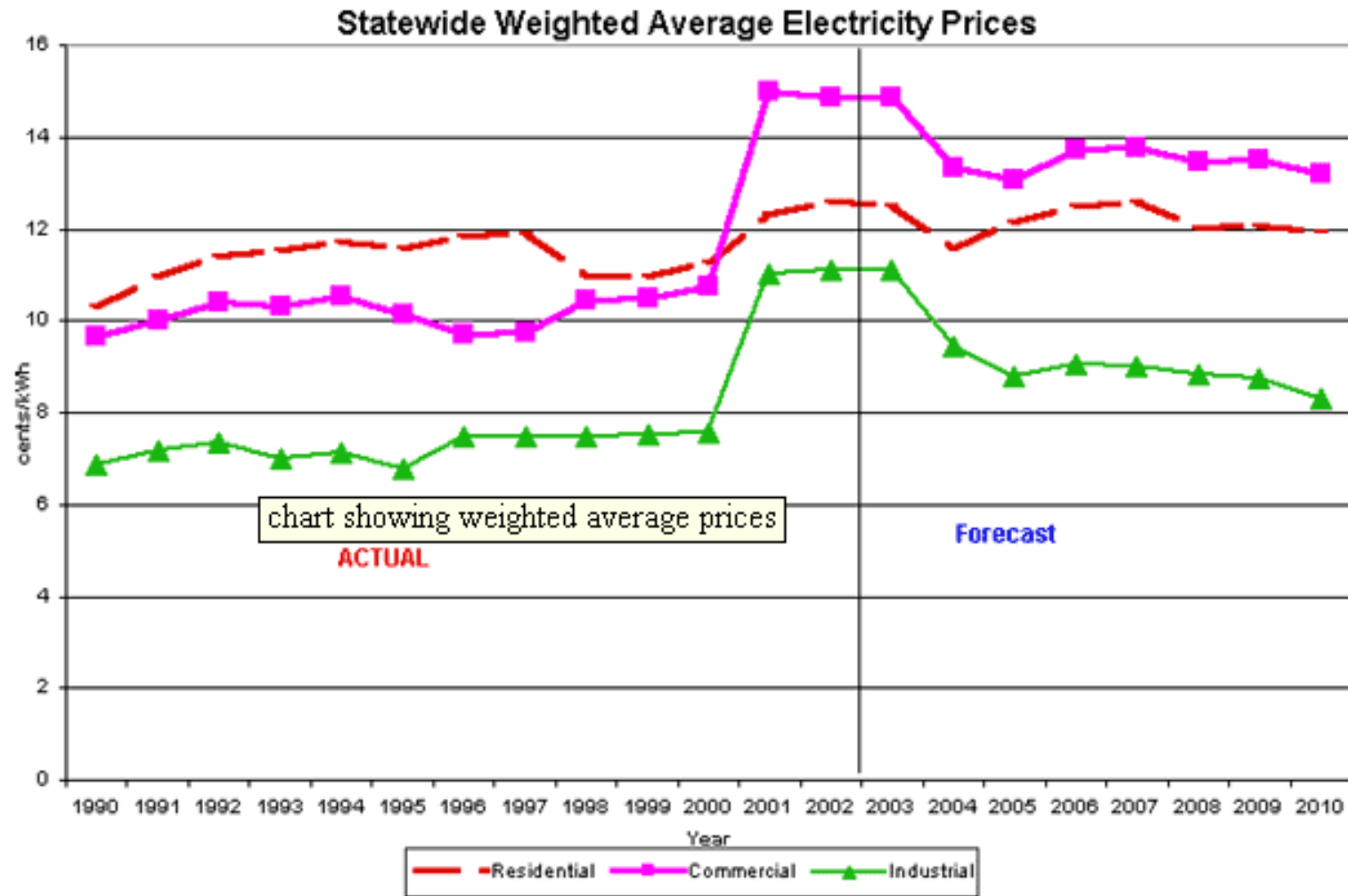
# Four Key Value Propositions



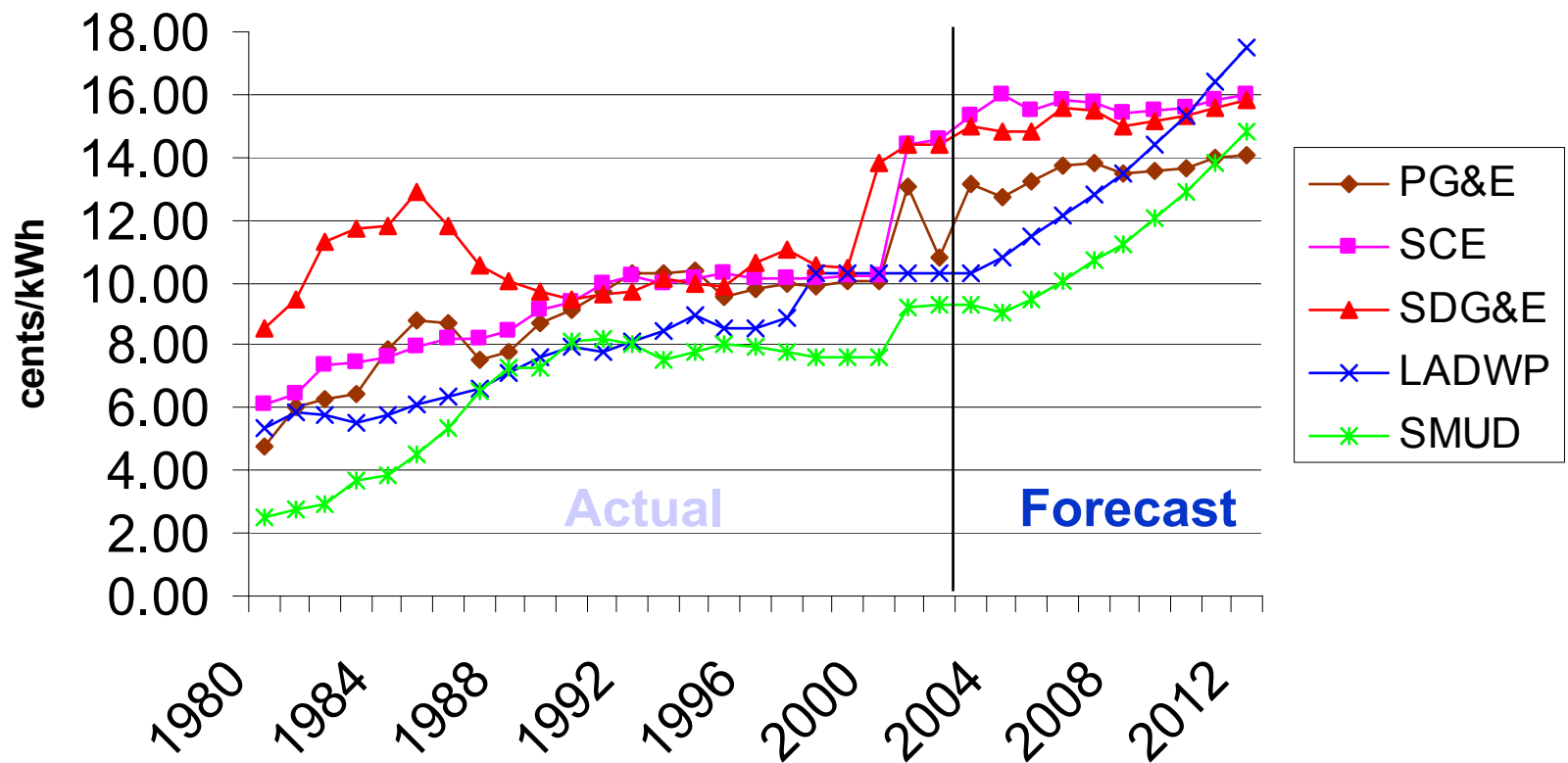
- V1: Power Availability
  - Can be off-grid or on-grid. Will tend to be continuous with generally high utilization rates (above 5,000 hours).
- V2: Power Reliability and Quality
  - Require very high reliability, 99.9999 uptime (5 or 6 “9’s”).
  - Experience frequent problems with utility.
- V3: Power Price Insurance and Hedging
  - Provide a hedge against very high peaking prices
  - Negotiate an interruptible power contract
- V4: Energy Optimization
  - The value proposition focuses on the sale of MP applications that optimize the client’s total energy needs and bill.
  - Most often a cogeneration application.

## CA Statewide Weighted Average Electricity Prices

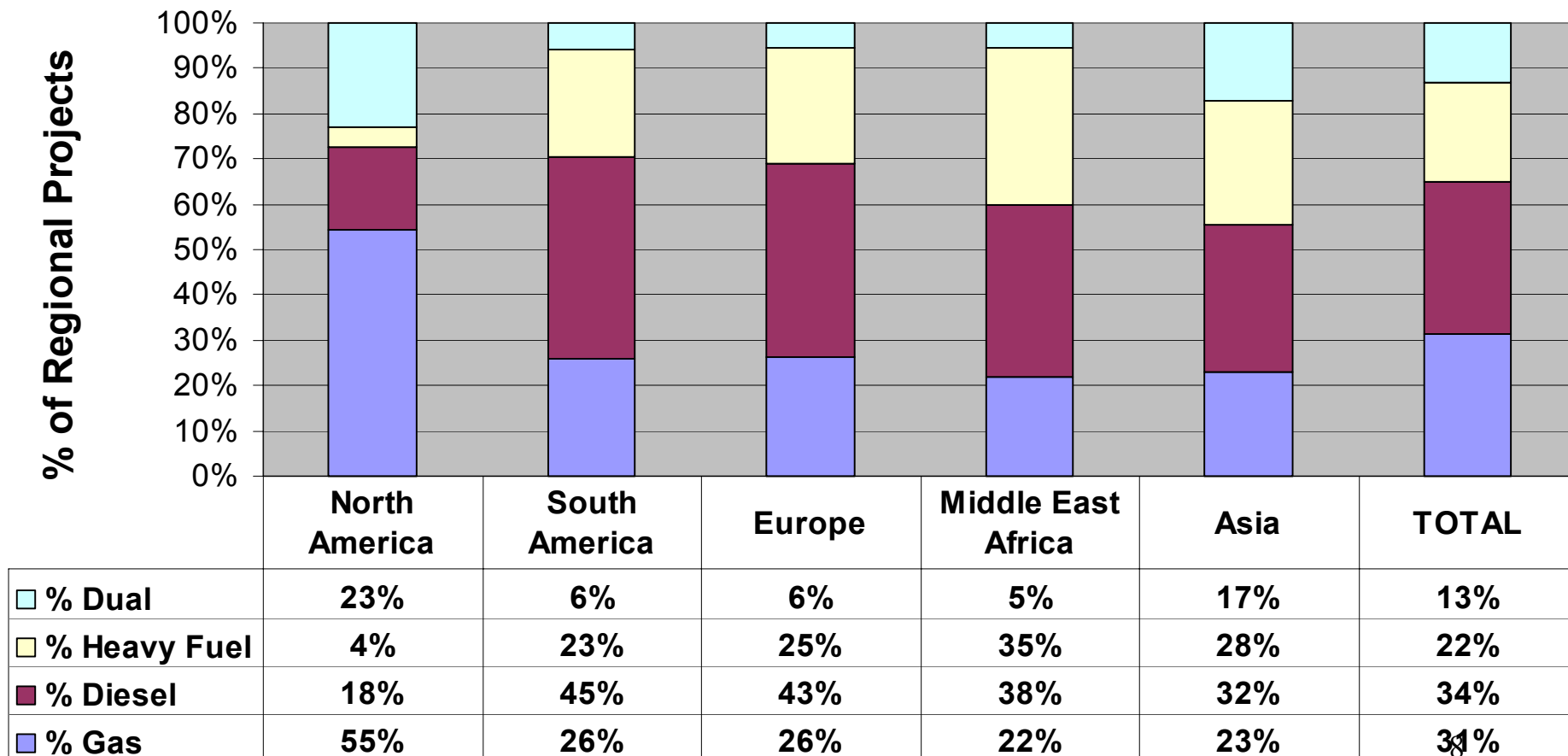




# Utility-Wide Weighted Average Retail Electricity Prices



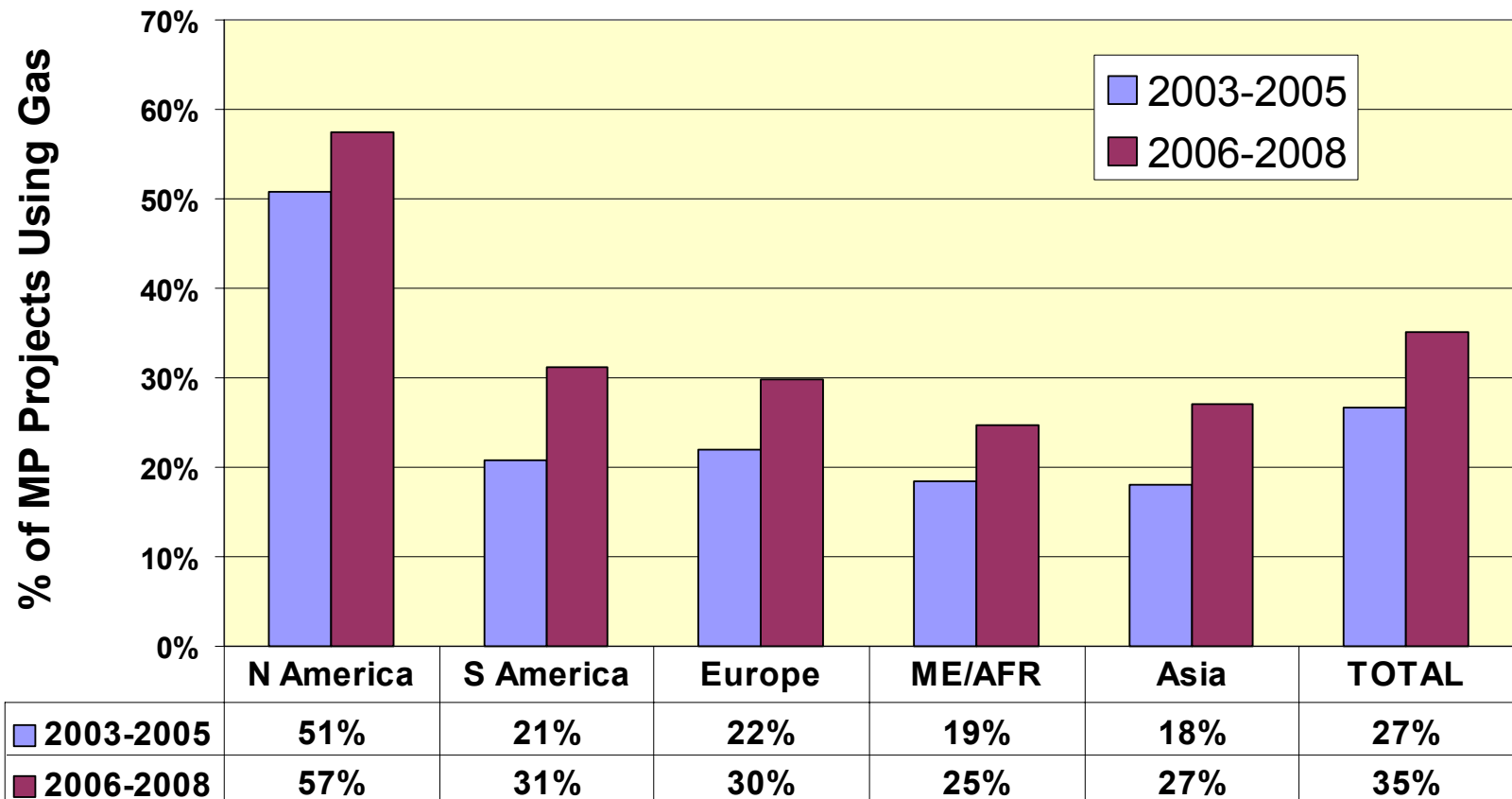
# World MP Forecast by Region & Fuel Type





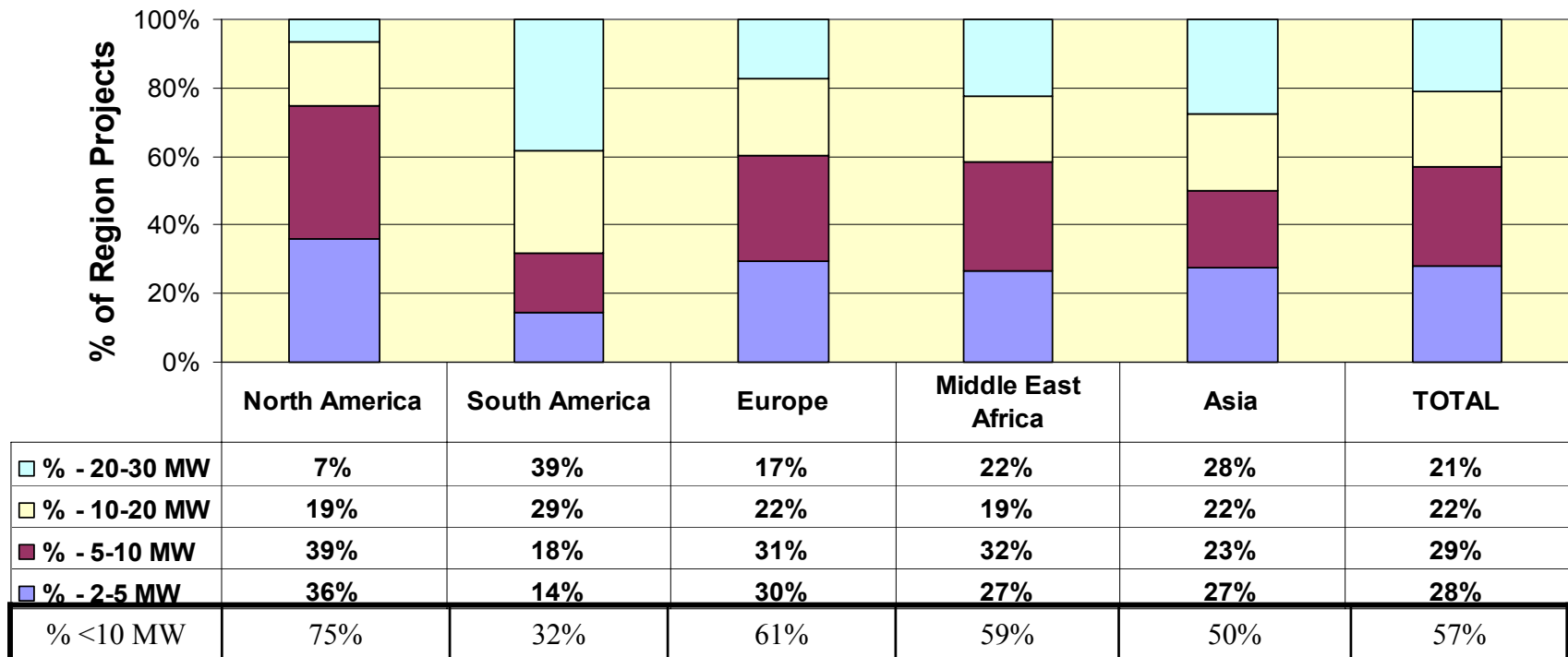
# Gas Gains in Mid Power

## MP Forecast: Gas Gains in Percentage Share

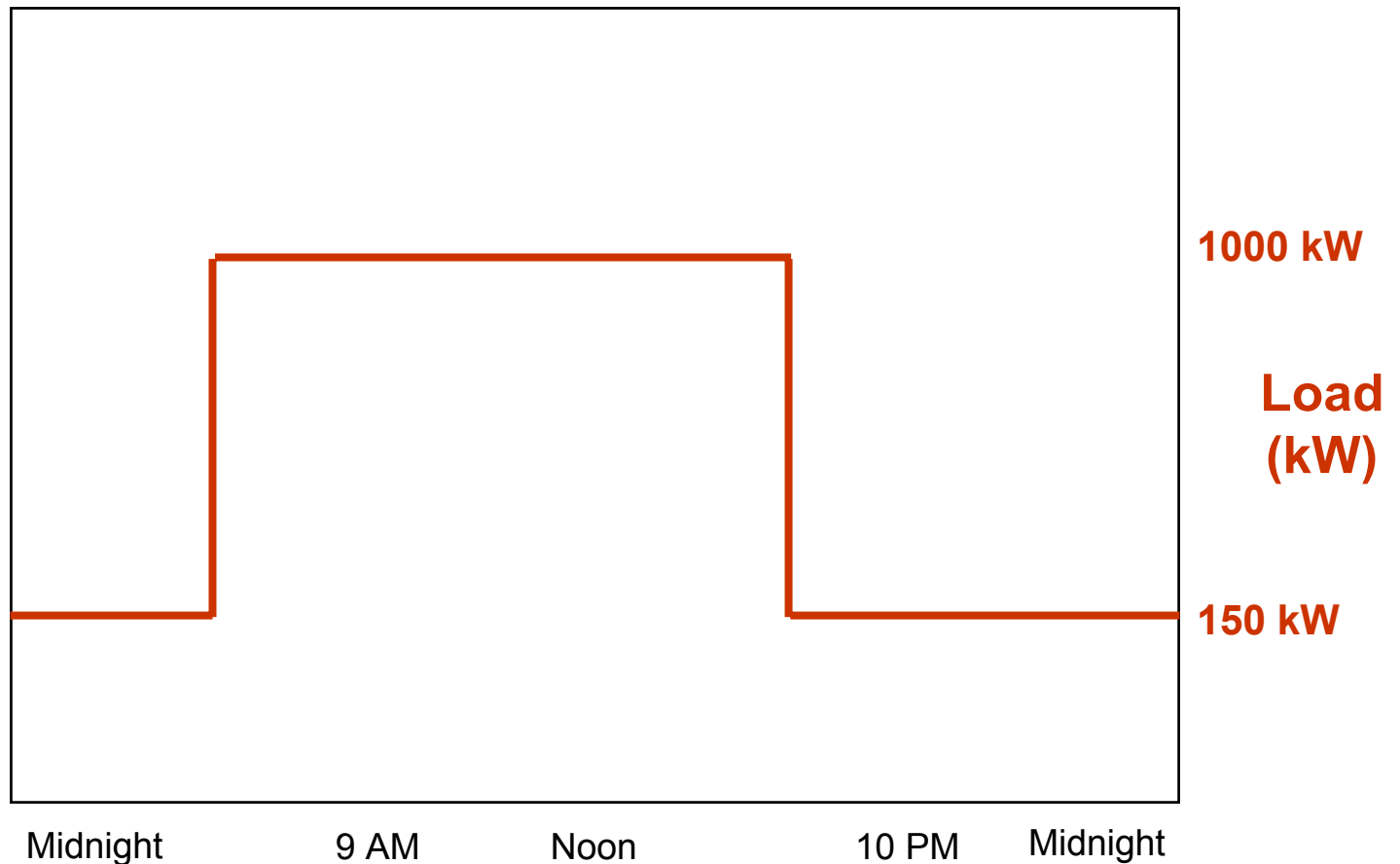


## World MP Forecast by Region & Project Size

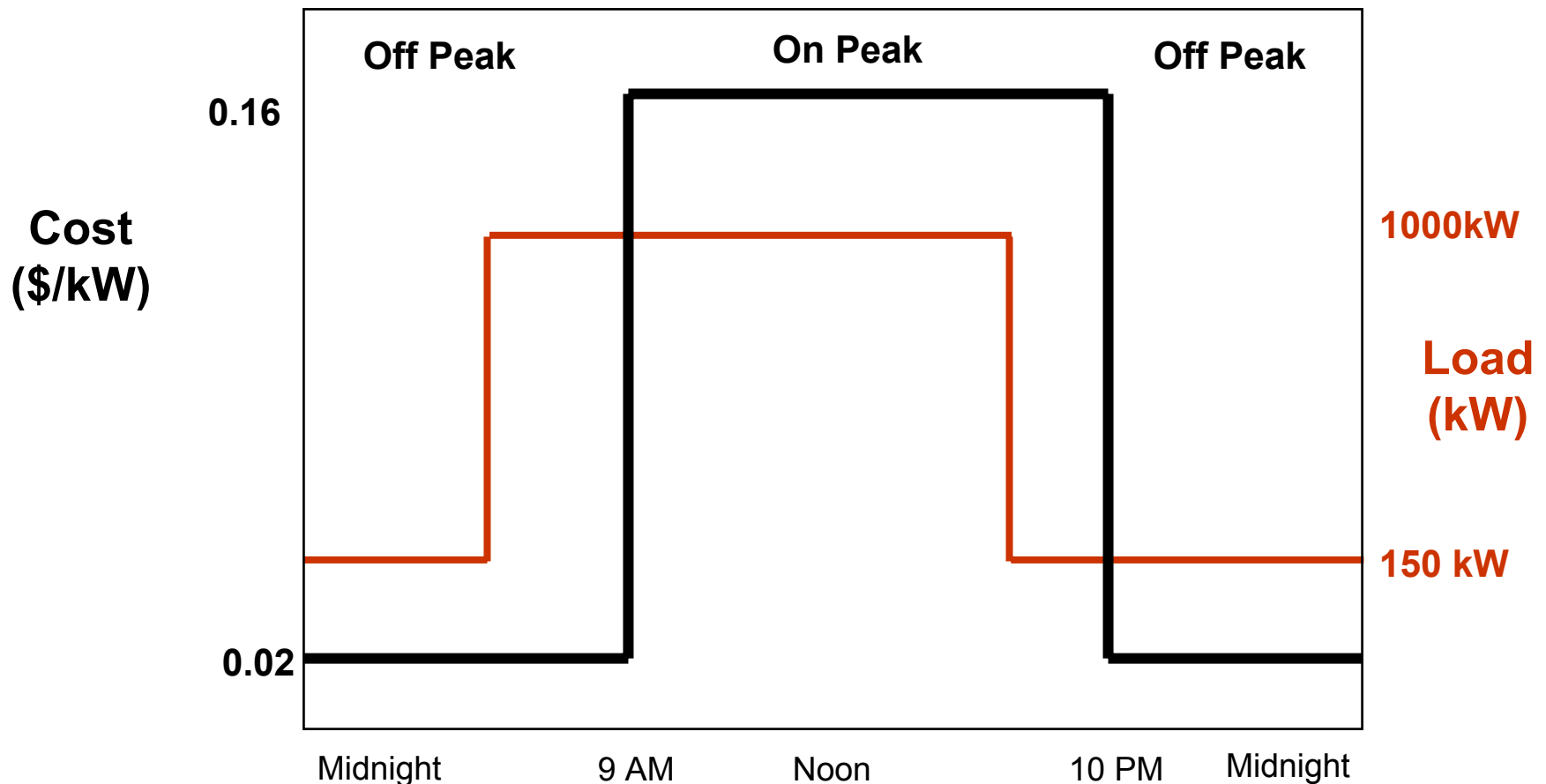
**Worldwide, projects below 10 MW will account for 57% of the 2-30 MW project size.**



## Typical Daytime Operation - Commercial/Industrial Load Profile

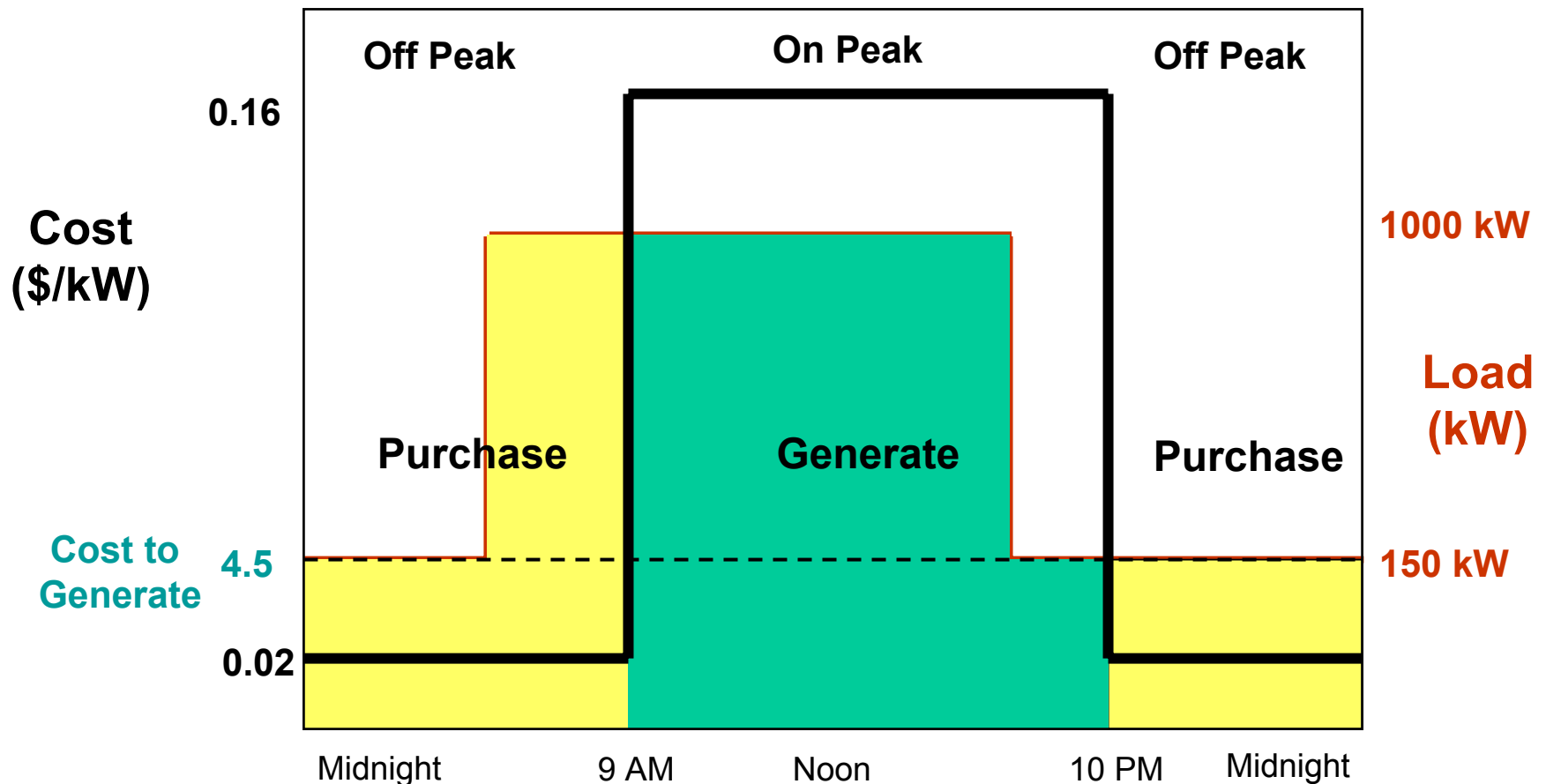


# Typical Daytime Operation - Commercial/Industrial Load Profile & Utility Cost Curve



# Optimized Daytime Operation - Commercial/Industrial

## Load Profile & Utility Cost Curve



QSV 81 & 91 High Efficiency Lean Burn Genset  
12:1, 500 mg/Nm<sup>3</sup> Nox, 203 deg F. HT outlet

<u>GENSET</u>	<u>CONTINUOUS RATING</u>	<u>ELECTRICAL EFFICIENCY</u>	<u>HEAT RATE</u>
QSV81G	1100 kW	38.2 %	8,937
QSV91G	1250 kW	38.5 %	8,868
QSV91GB	1750 kW	38.1 %	8,955
QSV91GB	2000 kW	38.1%	8,955

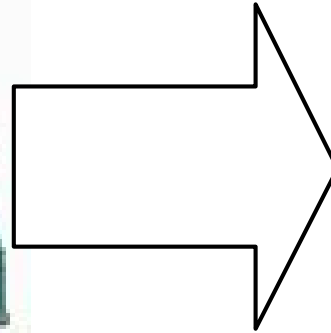
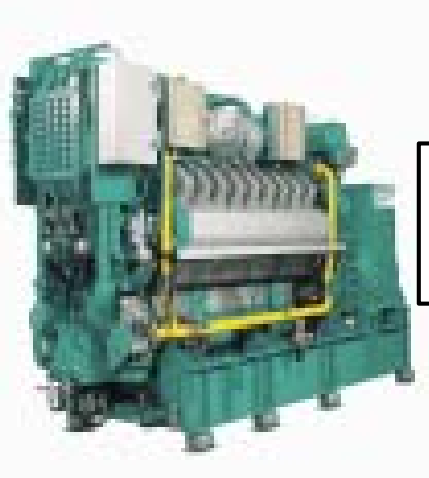
# Gas Turbines

## Gas engine advantage

	Electrical efficiency %	Overall efficiency %
Reciprocating gas engine	36–42	80–90
Gas turbine	18–30	80–90
Steam turbine	7–20	75–85

- Higher mechanical efficiency
- Lower installed cost
- Low gas pressure capability
- More suitable for load fluctuation
- No Time de-rating
- No water consumption
  - 250-300 gallons MW/hr
  - 3.5 - 4 gallon kW/hr
- Lower Noise emission
- Less affected by ambient conditions
  - temperature & altitude

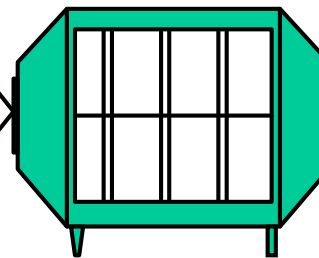
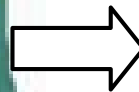
Emissions



NOx: 111 PPM / .8 g/bhp/h  
CO: 558 PPM



SCR/OXI



90% Open Loop SCR + OXI CAT  
NOx: 12 PPM / .08 g/bhp/h  
CO: 51 PPM / .23 g/bhp/h

BACT SCR + OXIDATION CAT.  
NOx: 6 PPM / .04 g/bhp/h  
CO: 56 PPM / .23 g/bhp/h



# 1750 GQNB and 1250 GQNA

- Technical Data

– Engine	Cummins QSV91
– Continuous Duty	1250 kWe to 1750 kWe
– Configuration	18 V
– Bore x Stroke	180 mm x 200 mm
– Capacity	91 liters
– BMEP	14 Bar to 16 Bar
– Aspiration	Turbo / After-cooled
– Compression	12:1
– Efficiency mechanical	39.9 % to 40.5
– RPM	1200 rpm to 1500 rpm



# 1250 kW Modular System



**10' Wide  
10' High  
40' Long**

**IN  
STOCK !**

# New Products



Product	1200rpm 39% electrical efficiency	1800rpm 38% electrical efficiency
QSK45G	700 kW	1050 kW
QSK60G	950 kW	1400 kW
QSK38G		36.5% electrical efficiency 650 kW

## Technical Data

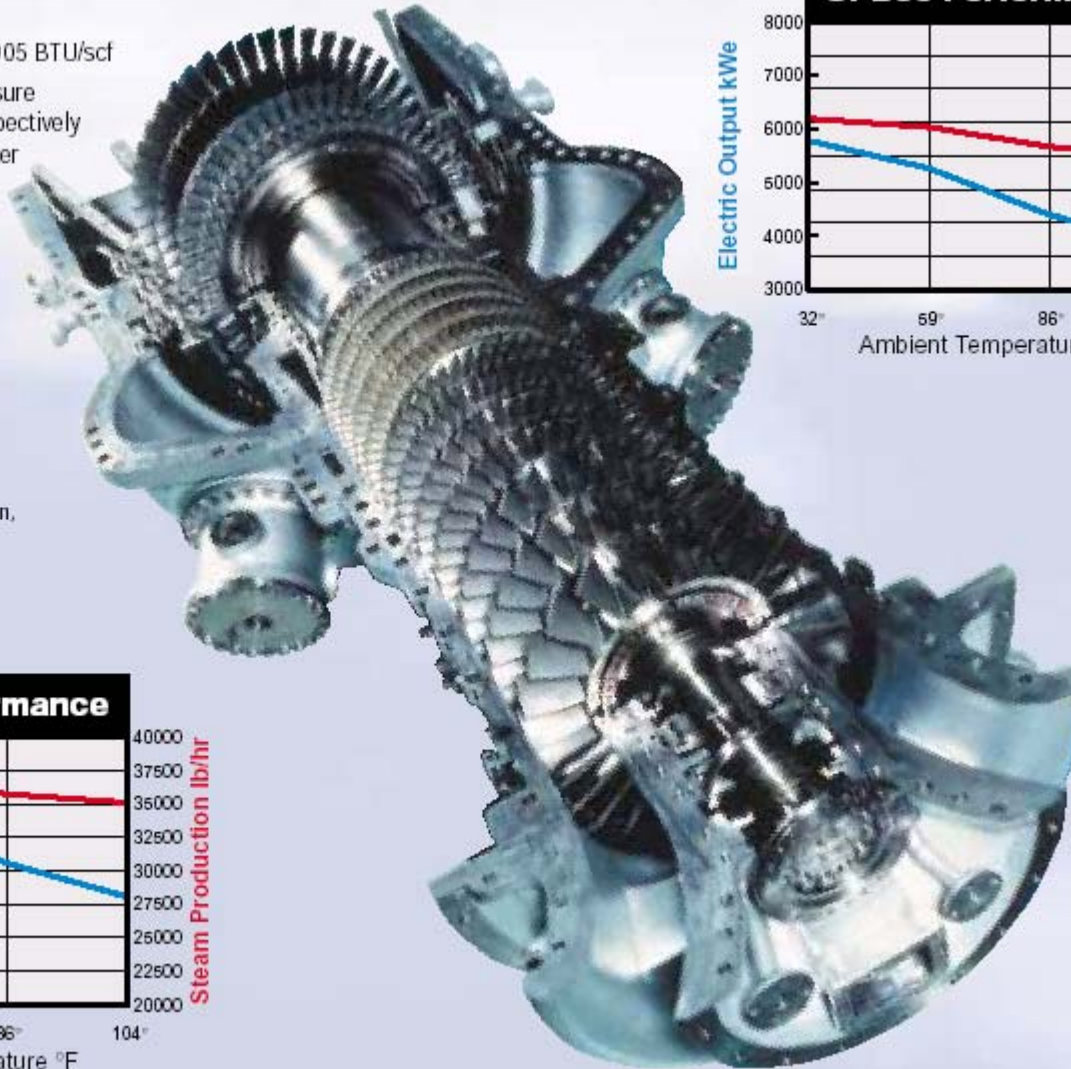
<b>Engine</b>	<b>Cummins QSK60</b>
<b>Continuous Duty</b>	<b>1400 kWe</b>
<b>Configuration</b>	<b>16 V</b>
<b>Bore x Stroke</b>	<b>159 mm x 190 mm</b>
<b>Capacity</b>	<b>60 liters</b>
<b>BMEP</b>	<b>14 Bar</b>
<b>Aspiration</b>	<b>Turbo / After-cooled</b>
<b>Compression</b>	<b>12:1</b>
<b>Efficiency mechanical</b>	<b>40 + %</b>
<b>RPM</b>	<b>1800 rpm</b>



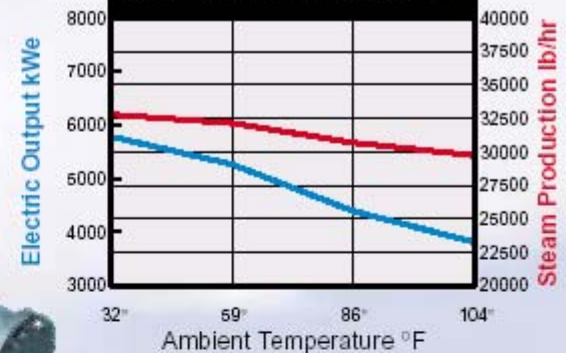
# Cummins & Kawasaki Turbines

## NOTE:

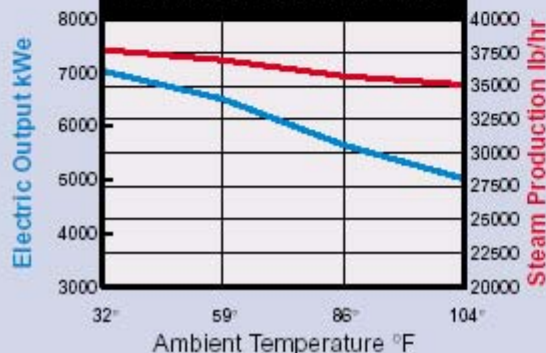
1. Fuel is natural gas with LHV=905 BTU/scf
  2. Sea level, intake/exhaust pressure loss: 4/10 inches of water respectively for GPB60, 4/14 inches of water respectively for GPB70.
  3. Generator efficiency 97%
  4. Contact Kawasaki for fuel consumption and emissions for other fuels
  5. Required gas pressure:  
GPB60 – 242 psig  
GPB70 – 300 psig
- \* Steam production is based on deaerated feedwater temperature of 228°F, 2% continuous blowdown, 125 psig saturated steam at non return valve outlet.



### GPB60 Performance



### GPB70 Performance



- Cost of onsite generation is made up of 3 main components
  - Fuel
  - Maintenance
  - Capital

**\$4.00 /mmBTU**

12:1 compression, 203 Deg F HT Outlet, High Efficiency Engine

QSV81G	1100 kW	9.83mmBTU/hr	\$.0393kW/hr
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QSV91G	1250 kW	11.08mmBTU/hr	\$.0389kW/hr
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QSV91GB	1750kW	15.67mmBTU/hr	\$.0394kW/hr
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**Fuel cost pricing has been converted to HHV**

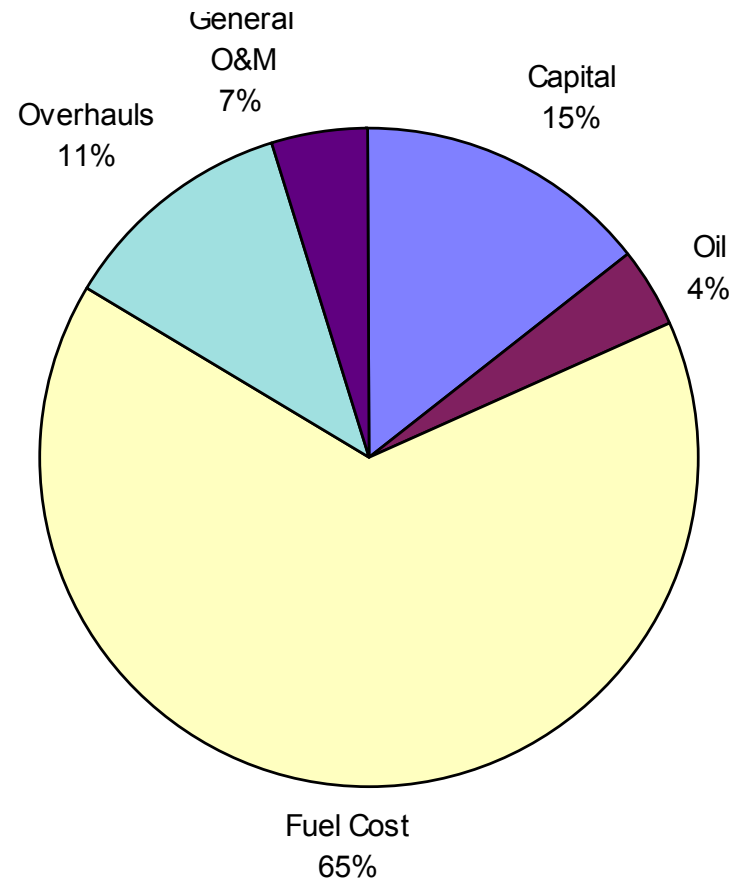
## Fuel Cost of Generation / Diesel

\$0.95 per gallon

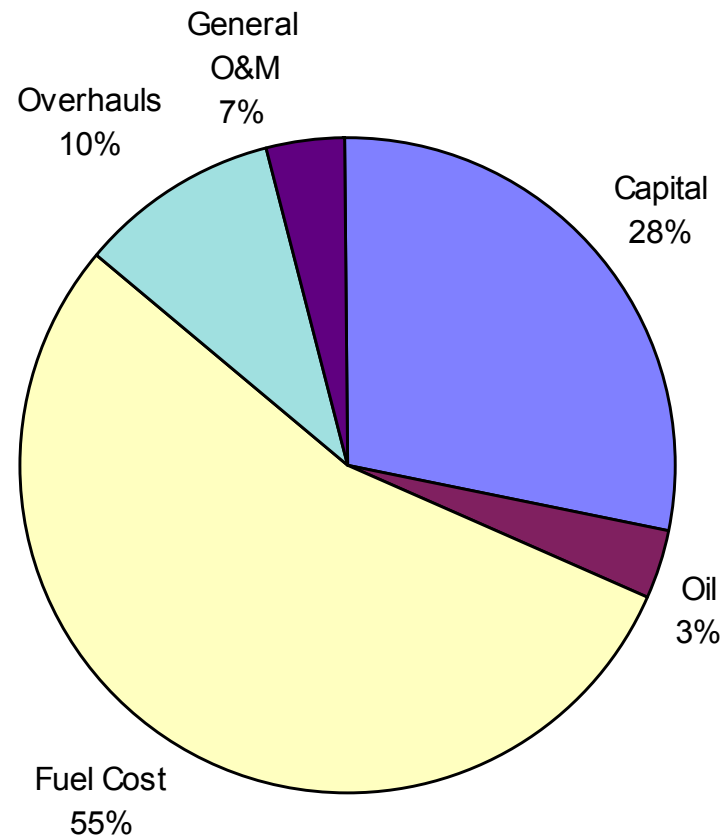
<u>Prime Rating</u>	<u>Engine Size</u>	<u>Gallons / Hr.</u>	<u>Cost / kWh</u>
1825 kW	60 Liter	122.0	\$.0635
1250 kW	50 Liter	87.3	\$.0663
900 kW	30 Liter	62.1	\$.0655



# Typical LCC Make Up 8000 Hrs/Yr 10 Yrs



## Typical LCC Make Up 3400 Hrs/Yr 10 Yrs



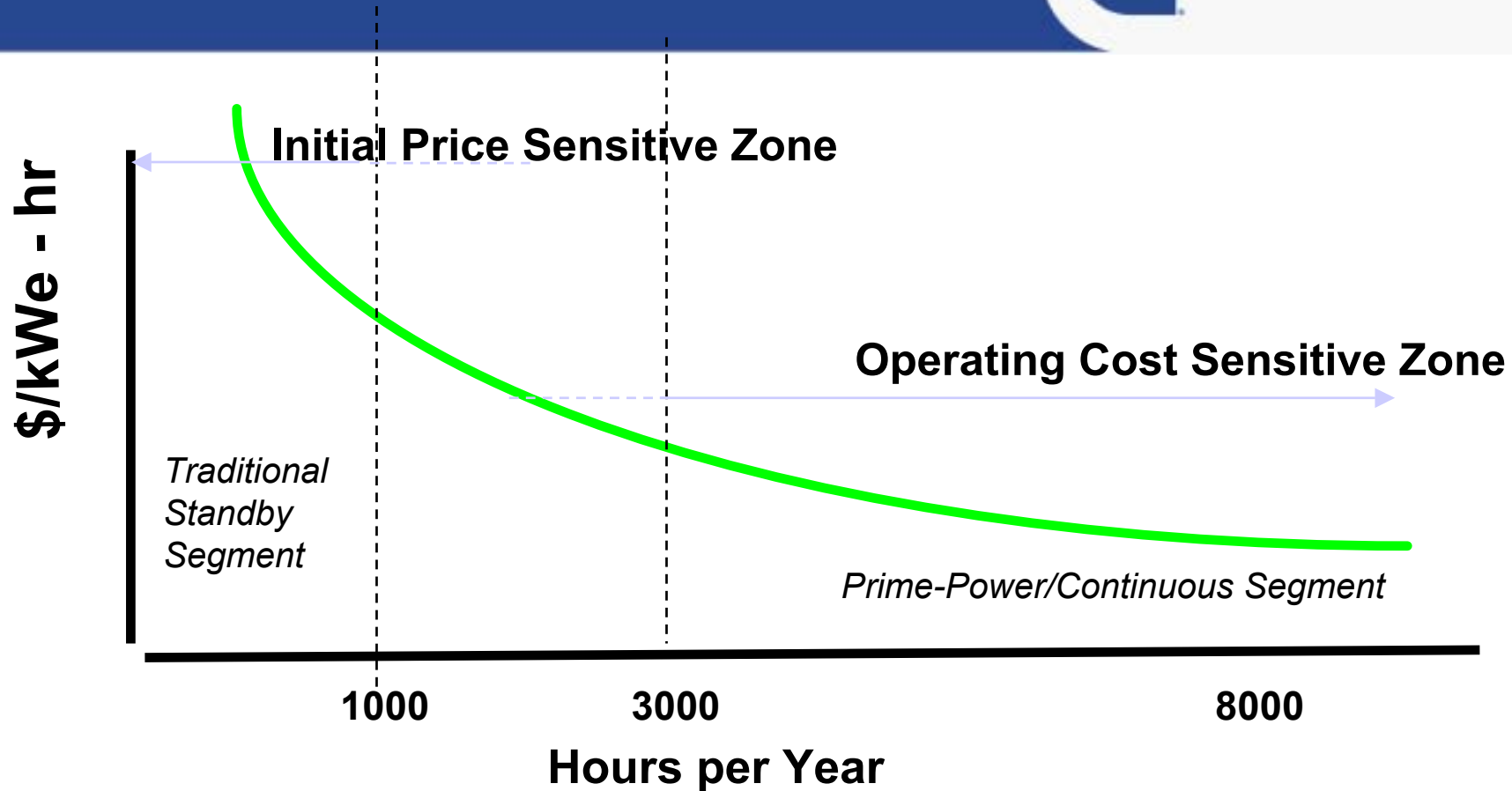
- **Scheduled & Unscheduled Maintenance Agreements.**

- **Available 1 - 10 years of project for Cummins scope of supply**
- **Genset, switchgear, cogen & SCR.**
- **Cost range \$.009 - .013 kW/hr**

## ▪ **Unscheduled Maintenance**

- **Provisions**:- from 15% to 25% of the amount of the Total Scheduled Maintenance Cost. Facility included in LCC model at approximately 15%





**When is LCC Important:**

# What are the Key Drivers:

## Load Factor:

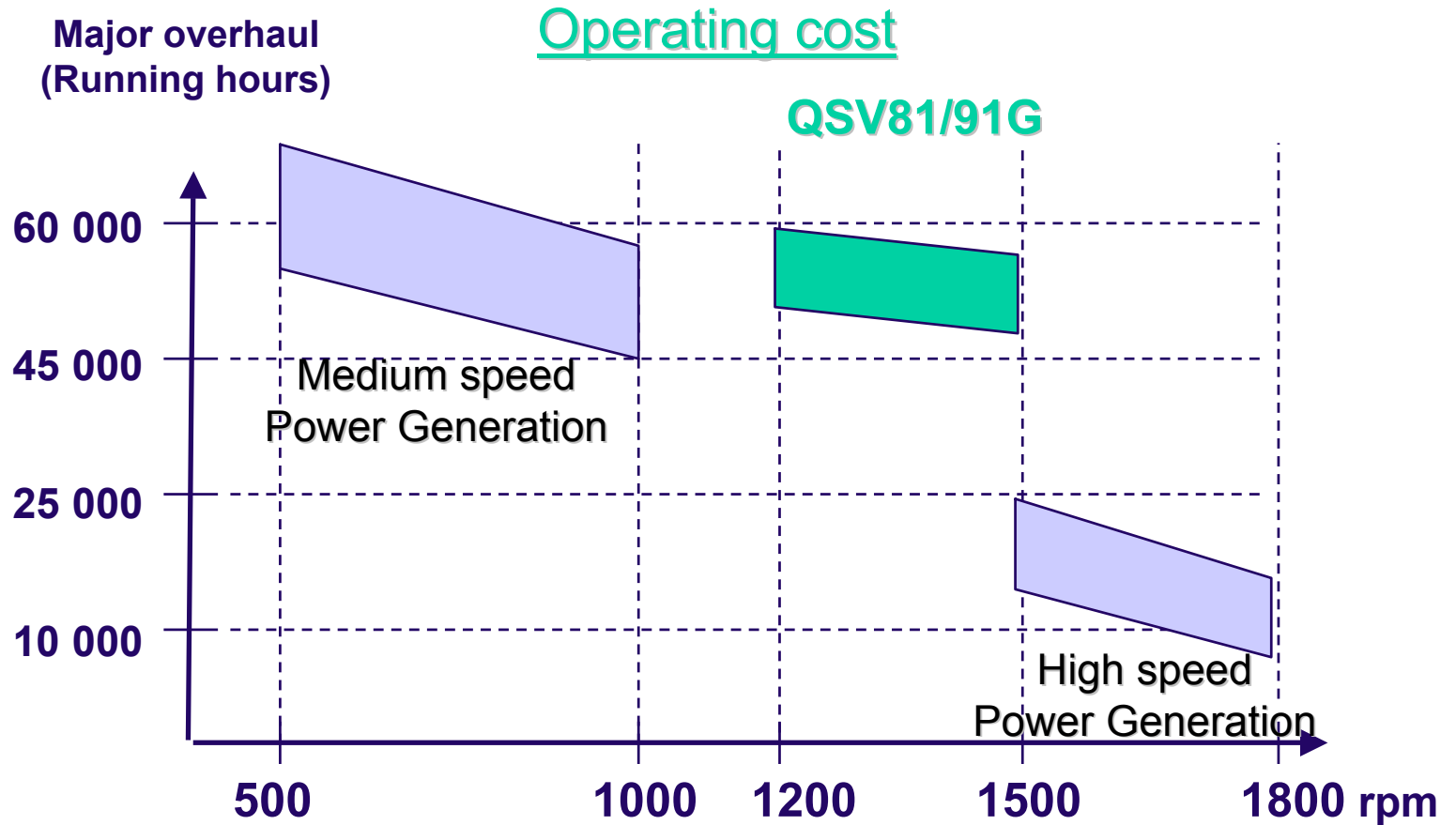
*Why?*

Fewer kW-hrs generated while operation cost don't decrease proportionately as fast.

*\$/we-hr*

25% 50% 75% 100%  
*Load Factor*

*Load Factor  
Influences LCC*



# Cost of Capital

- \$800.00 - \$1,500 / kW
- 6.5%
- full pay out lease, no residual value taken
- 5 years \$0.0237 - \$0.0444 / kW installed
- 10 years \$0.0137 - \$0.0257 / kW installed



# Total Cost of Generation

- Fuel                      \$0.039 kW/h
- LCC                      \$0.009 - \$0.013 kW/h
- Capital                \$0.0137 - \$0.0444 kW/h
- Total                    \$0.0617 - \$0.0964

# RULE OF THUMB

QSV81G produces approx 0.8 ton /hr of 338°F steam at 116 psig.

QSV91G produces approx one ton /hr of 338 °F steam at 116 psig

# APPLICATION - HOSPITAL

2 units  
QSV91G  
1200RPM

Electrical  
Output  
2.47 MWe

Thermal  
Output  
3,400 kWth



St Catharines Hospital,  
Ontario, Canada

## APPLICATIONS - AGRICULTURAL

6 units  
QSV91G

Electrical  
Output  
9.1MWe

Thermal  
Output  
10,500 kWth

Uses CO<sub>2</sub> to  
enhance growing  
cycle



Nedalo, Hernhill, Kent, UK

# 21 MW Atmos





# Generator Line Up



# 16 MW Senegal Base Power Plant

- 5 months from contract to operation
- 3 year contract for operation and maintenance



# McMinnville Electric System



**Eleven 2 MW DQK Gensets**

- **At a Glance:**
- **Where:** McMinnville Electric System in McMinnville, Tennessee
- **What:** 11 x 2 MW diesel-fueled generator sets, featuring PowerCommand pre-integrated controls.
- **Purpose:** Peaking power and emergency backup power for the Tennessee Valley Authority (TVA)..



## North American Installations

- **Vandbro Corp- Asphalt plant, Staten Island**
  - 1.25 MW Cogen, 4,000 hrs/year
- **Museum of Science & Industry, Chicago**
  - 1.75 MW Cogen, 3,400 hrs/yr
- **St. Catherines Hospital, Ontario**
  - 2.5 MW Cogen System, 7000 hrs/yr
- **St. Charles Hospital, Toledo**
  - 1.1 MW Cogen System, 3000 hrs/yr
- **A.E. Staley/Atmos, Tennessee**
  - 21 MW Peaking, Max 1,200 hrs/yr

## North America Installations

- **Gas Technology Institute, Chicago**
  - 1.1 MW Cogen absorption , 3,400 hrs/yr.
  - Comparison test site with Cat 3516
- **Equity Office Partners, Chicago**
  - 1.1 MW, Cogen, 3,400 hrs/yr
- **West Lincoln Memorial Hospital, Ontario**
  - .66 MW cogen system, 4000 hrs/yr
- **New Orders**
  - Dupage County Water Treatment, 1.1 MW
  - 2 High Schools 2 @ 1750 kW